The Journal

OF THE AMERICAN SOCIETY OF SAFETY ENGINEERS

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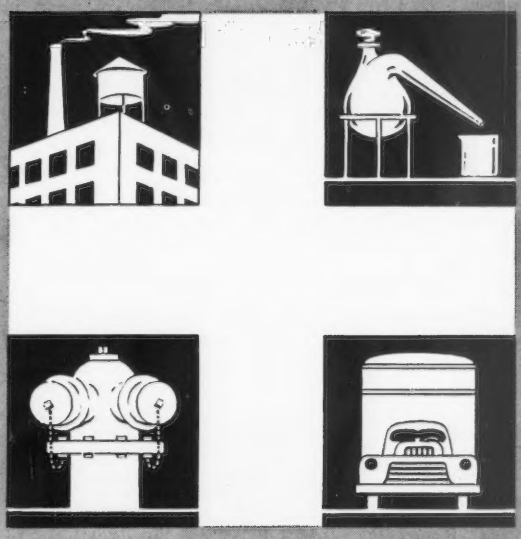

MAY, 1961
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Unusual Articles Featured In this Issue of the Journal

■ AN UNUSUAL COMBINATION of articles are featured in this issue of the *Journal* which should appeal to the safety engineer. C. W. Rose and John A. Dickinson, in their paper "When Are Safety Belts Unsafe?" outline a simple but effective method for testing safety belts (page 18). Dr. J. N. Peterman, director of psychological research for a Chicago advertising agency, provides some new insights into the problem of management resistance to participation in safety programs in "Selling Safety to Management – Some Psychological Considerations" (page 22). John W. Gurry, in a brief but compelling article, "A Safety Job or Job Safety" (page 26) talks about selling safety and John W. Leggat, Jr., peers into the future in his discussion of electronic control of passenger cars in "The Electronic Driver – Is it Coming?" (page 27).

With this issue of the *Journal*, only one more remains under the present format. The August *Journal* will end another chapter of Society publication history after almost six full years of publication (23 quarterly issues) and in October, the Society's new magazine will make its initial appearance. Preparations for the new publication are speeding ahead and reports of progress will soon be issued to the Society membership.

The Society's Technical Paper Award program will continue under the new publication and papers are now being accepted for the 1961 competition which closes June 30, 1961. Entries are being reviewed and papers *published* or *accepted for publication* by June 30 will be eligible for this year's awards.

– the Editor

AMERICAN SOCIETY OF SAFETY ENGINEERS

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5 North Wabash Avenue, Chicago 2, Ill.

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managing director

LEONARD LEVINE
editor

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OUR PRESIDENT SPEAKS ON SAFETY

BY NOW, I AM SURE that you have reviewed the January, 1961 issue of "Engineering For Safety" which contains the Society's annual report.

The section of the report which should be of real interest to chapters is the one entitled "Report on Society Chapters." Were you not impressed by the many activities of chapters in the areas of education and training, and public and community safety? Herein lies one of the many avenues to increase recognition of the value of the safety profession to a community.

An A.S.S.E. chapter can meet the requisites of the Society by doing little more than meeting each month and by engaging in only Society business. This minimum type of program however, fails to take advantage of the tremendous potential available in a chapter to enhance the stature of the safety engineer in the eyes of the public and business community and thereby open greater opportunities to him. The chapter must be constantly alert for ways in which it can render service and initiate action where it feels that it will be of benefit or where it is needed.

Has your chapter approached vocational school authorities to offer assistance in establishing shop safety programs? Is it promoting school safety through the P.T.A.? Is it working with Junior Achievement? Does it collaborate with local safety councils in the sponsorship of traffic safety programs and conferences? These are just a few of the areas in which time, effort and money can be expended profitably.

Is your chapter carrying its educational programs to all groups even legislatures and code making authorities and agencies? There exists a lack of understanding of the role the Society or its chapters should or could play in this field. We are planning to develop certain policy directives on this subject later this year.

A tax exempt organization such as ours cannot aggressively seek to promote or oppose legislation as a substantial part of its activities. As an organization directed to educational and research work in the field of accident prevention, we can however, provide information to anyone who has an interest in such matters.

If legislation is proposed in a state, it would be perfectly proper for the chapters in that state to carefully study such proposed legislation if it pertains to the field of accident prevention. After such study it is also perfectly proper to write to the legislators or others and submit information which will be helpful to those concerned in making an intelligent decision.

Similarly, in the study of regulatory codes, it is not uncommon for states and local governmental agencies to secure the advice and recommendations of technically qualified persons in the field. Here again, the chapter or chapters can provide information which will help make the codes and regulations workable and sound.

This type of educational activity is one that is both worthwhile and necessary to achieve the purposes of the Society. When the information is insufficient this indicates the need for further study and research with which, of course, we should be concerned.

If the American Society of Safety Engineers is to become a positive influence in the advancement of the safety profession, its activities must encourage in the eyes of the public, of industry and of other technical societies, the "image" of a society which officially and solely represents the safety profession. Although national committee activities can be instrumental in creating this "image," it is best accomplished at the chapter level through participation in local technical society affairs, school and college safety, and community safety.

George L. Gorbell

GEORGE L. GORBELL, PRESIDENT
AMERICAN SOCIETY OF SAFETY ENGINEERS

When Are Safety Belts *Unsafe?*

by C. W. ROSE and JOHN A. DICKINSON

WHEN DO YOU DISCARD a used safety belt? This question has no pat answer, and is one that has posed a serious problem to industry ever since safety belts have been used. Ironically, safety belts cannot be strength-tested and then put back into service, because any test which is severe enough to *prove* safety, may so damage the belt as to make it unsafe after the test. On the other hand, belts cannot be economically discarded according to any calendar schedule, for some belts may have had many times the wear or damage as others of the same age.

This problem was the subject of an article by C. W. Rose in October, 1948, entitled "When Can We Stop Guessing About Safety Belts." Another article on this subject appeared in March, 1953, entitled "How Safe Is That Safety Belt." Those articles outlined the "Safti-graph" method of testing belts. This paper simplifies the test method, suggests test procedure and specific standards and provides a complete, practical program.

A full-load test – carried to complete destruction – is the only test which should ever be applied to safety belts. The information gained from such testing must be preserved and used as an experience guide for inspections in the future. Belts should be approved or discarded solely on the basis of visual inspection. It is absolutely essential, therefore, that this inspection be done by someone who has adequate criteria and training upon which to base his judgment.

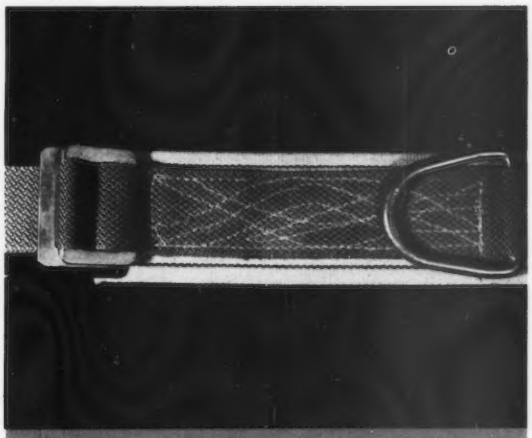
The program should start with the most worn or deteriorated belts in service, or in other words, the ones presumably ready for discard. Very little loss is involved in destroying such a belt; certainly a far greater loss is risked if it is kept in service. All such belts should be taken out of service and tested until the accumulated data is sufficient to give adequate criteria for judgment. Later in the program only unusual conditions will require further testing.

For use in testing worn construction workers' belts, a static load test is suggested for several reasons. It measures the strength of each belt from weakest to

C. W. Rose, Colorado Chapter, is president of Rose Manufacturing Co., manufacturers of safety equipment. Mr. Rose's career in designing and testing safety equipment goes back to 1915, when he and his brother started the Student Window Cleaners service, forerunner of the Rose Co. He joined the Society in 1944 and this is his first *Journal* article.

John A. Dickinson, safety consultant and former chief of the Codes and Specifications Section, National Bureau of Standards, has been in safety work for more than 50 years and is a charter member of the Society and its forerunner, the United Association of Casualty Inspectors. This is Mr. Dickinson's second article in the *Journal*.

George Bronson, safety director of Morrison Knudson Co., left, shown with Author C. W. Rose, testing used safety belts.



The critical wear section of a construction worker's safety belt is shown in this picture. The belt is new.

strongest. It is usually the most convenient method. Equipment is normally available or readily devised (any heavy duty winch, crane, or hydraulic jack can be used for power).

Also it is a safe guide for judging impact. For example, if a belt will stand 4,000 pounds of static load, it will stand somewhat more than 4,000 pounds of impact loading (such as occurs in stopping a man at the end of a free fall). This has been established through research by the National Bureau of Standards, covering web straps and ropes.

MEASURE ELONGATION

In these tests on used belts, the loading should be applied in a pull from one Dee ring to a freely-rotating mandrel or cylinder inside the belt opposite the Dee ring. This will test the Dee ring and its attachment to the belt as well as other components of the belt assembly. Elongation of the belt should be measured during the test and a record kept of such elongation, whether due to stretch, slippage, tearing or other factors. This is essential, because elongation, in case of a workman's fall, might cause him to slip out of the belt upon impact.

Since elongation will be influenced by the size of the mandrel and by the adjusted length of the belt, standards must be set for these measurements. We suggest, therefore, a 10-inch diameter mandrel as convenient and practical, and that the belt be adjusted to a circumference of 36 inches inside. The testing machine should be run at a speed slow enough to get an accurate measurement of the elongation of the belt.

Since the tests and test records are solely for the guidance of human judgment, and since a safety factor is included in the suggested test standard to cover inaccurate judgment of the inspector and additional wear until the next inspection period, slight inaccuracies in the test procedure are acceptable.

Elongation should be measured during the test between the two heads of the test rig, beginning at a loading of 50 pounds to eliminate all slack, and ending at a loading of 4,500 pounds. A total elongation distance between these two measurements of 4½ inches if due to elastic stretch, or of 1 inch if due to slippage, tearing or other defects, should be ruled unsafe. However, if the belt is to be used with a shock absorber, the maximum elongation distance should be considered as 3½ inches at 2,500 pounds of loading.

A realistic standard for approving or discarding used belts would be to discard all belts have an estimated strength under 4,500 pounds if the belt is to be used without a shock absorber. However, if a shock absorber is to be used with the belt, 2,500 pounds should be set as the safe limit for continued use because an adequate shock absorber will keep the impact loading on the belt, as well as on the user well below the 2,500 pound limit.

BASED ON AUTHORITATIVE STUDY

These recommended 4,500 and 2,500 pound limits are based on an authoritative study by a research committee of The American Society of Safety Engineers which was published by the National Safety Council in 1952 under the title "Final Report on the A.S.S.E. Research Project: Safety Belts, Harnesses, and Accessories." That report stated the conclusion that "an impact of 4,000 pounds is almost certain to result in injury, and that such equipment should be so designed that impact forces produced in stopping a free fall will be limited to 2,000 pounds."

Since belt failure usually results in sudden death – *a far greater hazard than the pressure of the belt against the body* – it follows that 4,000 pounds should be the absolute minimum permissible strength of a belt if it is to be used *without* a shock absorber. Setting the inspection standard at 4,500 pounds provides a safety factor to cover human error of the inspector, as well as wear and deterioration until the next inspection.

Inspections should be frequent, depending upon the uses of the belts. This, too, can be determined only after the program has been put into effect. Belts judged inadequate for full impact duty may still be used where the possibility of severe impact is eliminated.

This 2,500 pounds strength is for use *with* shock absorbers and 4,500 pounds strength for use *without* shock absorbers. It is *not* recommended that belts be tested to these loadings and then put back into service. As stated earlier, a test of this severity may damage the belt so much that it will have far *less* strength after the test. It is recommended these belts be judged by visual inspection and any belt with estimated strength below these limits, be discarded.

DEFINITE CRITERIA NEEDED

The inspector must have experience and training for such judgment, as well as definite criteria on which to base his decisions. For this purpose it is essential to preserve the tested belts with their recorded data, including an adequate photographic record.

This record should start with large (minimum 8″ x 10″) clear picture of belts in use or to be used, together with accurate test data on such new belts. Similar pictures of all *used* belts with detail shots of the most damaged areas, taken both before and after testing must also be kept, together with their test data.

The inspector will soon learn to judge belts with the common types of wear or damage, and later, unusual cases. Copies of these photos and test data can then be carried into the field on inspection trips, or sent to other branches or locations, as inspection training aids. It is essential that the inspector be able to judge belts with reasonable accuracy, as well as convince others of the validity of the tests and accuracy of his decisions.

Now, what about lanyards or life lines – sometimes called tail lines.

A steel cable lanyard without shock absorber should *never* be used where a free fall of more than a foot or so is possible. The cable's rigidity is likely to deliver a jolt far in excess of safe limits. A steel cable should be used *only* for positioning the workman to his job, and then only where the possibility of free fall has been eliminated, or reduced to an absolute minimum.

One-half inch manila rope should not be used if a free fall is possible. It is both too *rigid* and too *weak*. Its total straight line strength when new is only 2,650 pounds. This will be reduced approximately 10 per cent by any splice, and up to 50 per cent or more by any type of knot.

A three-quarter inch manila rope has adequate strength if used with splices instead of knots. The longer the better if it is anchored far above the workman's head so he will be protected by the yield or stretch a long rope provides. One-half inch *nylon* rope is ideal for lanyards because of its great strength as well as great elasticity, which cushions the jolt.

Lanyards should be subjected to *two* kinds of tests, static and dynamic, but *not* both types of tests on the same lanyard. For the tests, similar methods and standards as used on belts may be employed. However, a simple static load test on a lanyard measures

Loading and elongation of window cleaner's belt is measured to determine ability to take impact loading.

Jonathan E. Sharp, vice president of Kase Manufacturing Co., demonstrates test of construction belt for visitor.

only the *strength* of the lanyard. It will give no indication of the magnitude of free fall it can decelerate, nor the amount of impact it will transmit to the belt and its wearer. This is where dynamic testing is required. Dynamic tests can be made with strain gauge equipment, if available, or by use of the safti-graph method mentioned earlier.

A single drop test without strain gauge or saftigraph measurements merely shows whether the lanyard broke or held. It gives no additional information as to just *how* strong the lanyard was or the magnitude of drop test it *could* take. Such information is vital for the proper training of the inspector.

This information can be obtained by *progressive* drop tests. A simple and practical method is to attach one end of the lanyard to a 200 pound rigid weight, and the other end to a heavy chain or steel cable attached to a rigid support. Then from its position of rest, hanging from the lanyard, raise the weight just *one foot* and drop it freely.

Drop the weight *two feet* on the second test, three feet on the third test, and so on to complete failure. This gives a fairly accurate rating of the lanyard according to the number of drop tests it can withstand.

PROGRESSIVE TEST STANDARD

An adequate standard for progressive testing is a 200-pound weight progressively dropped up to the greatest possible distance a workman could fall in his use of the equipment. This will be on the safe side because the rigid weight will hit with greater force than would a man's body, and also because the progressive drops will usually cause failure at one or two feet less than would occur in a single drop test.

For free falls of any considerable distance (anything over a five or six-foot fall) a shock absorber should always be used. Two different kinds of shock absorbers are available. They are designed for different types of work, but either one of them will give adequate protection from damaging shock.

One is a Unolyn Coil Shock Absorber. The other is a spring clamp on a rope, known as a Rope Grab Shock Absorber. Either of these will hold impact loading down to well within the tolerance of both the man and the belt.

SPECIAL TEST PROBLEM

Window cleaners' belts present a special test problem, since the lanyard or terminal line is an integral part of the belt. This line and its connection with the belt must also be tested.

The American Standards Association has recently completed a new code on window cleaning safety. It is "Safety Code for Window Cleaning A 39.1." This code establishes a standard drop test for approval of new belts.

The test consists of a 350 pound *rigid* weight, buckled into the belt and dropped four feet, with only *one* of the window bolt terminals fastened. This code also specifies that belts must be constantly maintained in such condition as to meet this test. It is highly recommended that this new code be considered by all safety authorities.

We believe that each belt manufacturer should supply adequate photography and test data on his own new belts, but we firmly believe that inspection and check testing – of both new and used belts – should be done locally by an employee or by an independent testing laboratory. It should never be delegated to any manufacturer of belts.

A word of caution: all testing should be well shielded from personnel. Testing belts to destruction is hazardous. At the higher loadings, a broken piece of metal can become a projectile with lethal force.

SELLING

Dr. Jack N. Peterman is director of psychological research for Buchen Advertising, Inc. in Chicago. He has been active in the study and practice of applied psychology and market research since 1936. Dr. Peterman is a graduate of Rutgers University and has a master's degree from the University of Massachusetts and a doctorate from the University of Michigan.

I SHOULD LIKE to set the stage for this discussion by means of two short quotations – one from a recent National Safety Council Data Sheeet and one from an article in *Business Horizons*. The National Safety Council starts off its Data Sheet No. 483 on "Management Safety Policies" by stating:

> The attitude toward accident prevention on the part of top management in a company or a plant is almost invariably reflected in the attitude of the

SAFETY TO MANAGEMENT

Some Psychological Considerations

by DR. JACK N. PETERMAN

supervisory force; similarly, the worker's attitude is usually the same as his supervisor's. Thus, if the top executive is not genuinely interested in preventing accidents and injuries, no one else is likely to be. Since this basic fact applies to every level of management and supervision, an accident control program must result from top management's announced and demonstrated interest if employee co-operation and participation are to be obtained.

Similarly, Clayton F. Van Pelt, in a recent issue of *Business Horizons,* begins his article on "Industry's Inexcusable Accident Toll' with the theme statement that:

> Management's leadership is the major factor in every safety success story.

If this be so – and I find it difficult to imagine that anyone would seriously challenge these statements – then our topic here is not just *an* important one but rather, *the* important one for the members of this society.

Perhaps we can best approach our topic by analytically considering the question, "Why *should* management be interested in safety?" I would like to propose that there are three major classes of reasons:

1. The moral, ethical, or humane reasons
2. The existence of statutory or legal requirements
3. The cold cash, or monetary, considerations

Under the first category – namely, the moral or humane considerations – are subsumed such facts as that most, if not all people in management cannot avoid at least *some* feelings of responsibility for the loss of life or the occurrence of human suffering that accidents entail. Management people would obviously rather avoid or minimize guilt feelings that the occurrence of accidents inevitably involve. In addition, in our society, it is obviously a personal, moral virtue to do whatever is necessary to minimize human suffering by others.

The second major reason why management should be interested in safety is the fact that the law requires it. This is the area in which management has little choice or prerogative, as to what it will, or will not, do. The encoded specifications of our culture specify certain minimum requirements and, willingly, or unwilling, management has to fulfill them.

Finally, there is the matter of cost, to the organization, which accidents entail. Here we can spell out two somewhat separate though overlapping kinds of cost – direct costs and indirect costs. The direct costs in a company or plant, I am sure, are well known to you. These are:

- The cost of accident insurance
- The cost of damaged equipment
- The cost of spoilage, ruined materials and lower quality of products
- The appreciable cost of lower, or decreased output
- The cost of disrupted production schedules

The indirect costs of accidents are somewhat less commonly appreciated. Though the specific, indirect costs that accidents involve will vary from operation to operation, the following three are fairly common and will serve as examples.

On the one hand, high accident rates in a company or plant affect the good will in the community towards that company. Another effect of a high accident rate in a company is that it can, and often does, adversely affect the good will towards the company by customers – customers who find their delivery schedules upset by accidents. And, finally, there is the very appreciable, though difficult to define, effect on the labor market when potential employees know that a certain plant or company has a high accident rate.

These, in brief, are the reasons why management should, or must, be interested in safety. These are the reasons that you, as safety engineers are well aware of and, I am certain, have used and stated recurrently in your efforts to obtain management's cooperation in eliminating preventable accidents. But, they are far from the whole story.

If they were, there would be no need for the appreciable number of articles and discussions on this topic – including this one. There is obviously more to the picture. It is these other parts of the picture that I want to discuss now.

TWO MAJOR CONSIDERATIONS

I would like to propose that there are two major kinds of considerations that make the problem a problem – why management has to be *sold* safety. I would like to propose that selling safety to management involves the overcoming of appreciable resistence due to two casual factors:

1. The *costs* that safety measures and safety programs involve, and
2. The fact that management's active participation in a safety program involves the overcoming of very real, personal, psychological hurdles on the part of individual management people.

Insofar as the *costs* of safety is concerned, we can deal with them briefly. The major costs that are usually involved here are:

- The cost of protective equipment.
- The cost of safety devices.
- The costs of medical and first aid services.
- The costs of administrating safety services and programs.

Obviously these costs are often appreciable and, just as obviously, management can be expected to be very well aware of that fact. In the final analysis the cold economics of the business world will not permit a business man to continue any operation in which either the cost of accidents or the cost of preventing them exceeds the profit potential of his operation.

In this area, the job of the safety engineer is obviously to maximize the optimum. It would be truly presumptious if I were to attempt to tell you *how*, and *what*, needs to be done, and can best be done, in this area.

WHY MANAGEMENT RESISTS

There is one area, however, in which I might suggest some possibly new insights – namely, management's resistances to active participation in safety programs.

To begin with, I would like to call your attention to a psychological mechanism which has been found to play a very appreciable role in a somewhat different, though closely related field – insurance.

In studying the selling and buying of personal, as well as accident insurance, we have found that most individuals are all too often turned away from an objective consideration of their need for the protection that insurance offers by the ubiquitous feeling (usually buried in the adult's unconscious) that each of us is, after all, something special.

To a greater or lesser degree each of us clings to the feeling that the undesirable and catastrophic that happen to others can't happen to us. Deep down, each of us dearly harbors the conviction that, despite his experience to date, he is really Dame Fortune's favorite.

It is this underlying feeling (common and unrealistic though it may be) that gives rise to the attitude that says, "Oh sure, accidents happen – to others," and then by implication ". . . but not to me." The same fundamental mechanism with regard to purchasing insurance, also goes into operation in the need to take action concerning a safety program.

DIFFICULT TO ACCEPT

While the individual manager is ready and willing to accept, rationally, that accidents do occur in other people's operations and plants, he is loath to accept that this can happen to him (that is, in his plant, office or company). This is sometimes reflected in the half facetiously expressed attitude, "Why should I bet against myself?" It is as if, by admitting the possibility of misfortune, the individual were resigning his special prerogatives as a favorite of fortune and was thereby leaving himself open to, if not downright inviting, the occurrence of calamity.

In this connection it should be remembered that the kind of people we are talking about, namely, management, are much more likely to be affected by this kind of unconscious feeling, than is true of people in general. Remember, that we are dealing with

individuals who are likely to have experienced an appreciable degree of success in their work.

In spite of humorous gags to the contrary, most management people achieve their position by performing successfully their managerial responsibilities. Because of this, they are all the more likely to view themselves as favored by fortune. Under the circumstance, and unless his particular plant, office or business has just recently had a series of unfortunate accidents he is all the more likely to feel that it is improbable that misfortunate will strike him, or his.

There is however, another side of this coin – but it *is* the same coin. This is the fact that the desire to take steps to institute safety measures or a safety program is, in large measure, dependent upon management's uncertainty, or *knowledge* that it *cannot be certain* that accidents will *not* happen. It is this uncertainty, that is basic to management's need to consider the problem of safety.

"WITHDRAWAL REACTION"

Now, on the face of it, this would seem to require no further elaboration. It does require such elaboration however, because such uncertainty, especially as it relates to the moral, ethical and religious aspects of responsibility for the safety of others – this very same uncertainty is also frequently associated with nearly universal basic feelings of personal insecurity which are highly unpleasant and psychologically painful.

This, of course, is exactly the type of situation which normally produces what psychologists call "withdrawal reactions." Typically, when any experience or subject of consideration is painful or unpleasant, we draw away from it, and, if we cannot escape it in any other way we tend to "purposively forget it."

This is one of the reasons why some management men who, in terms of their reasonable knowledge and administrative obligation, should be more receptive to safety programs, find all manner of rationalization why specific safety steps cannot be initiated *now,* and keep putting off doing anything about it.

The very act of doing something about accidents is for some administrators an unpleasant admission of their own own limitations and, in addition to awakening their existing insecurity feelings, augments their tendency to withdraw from a situation which brings them into painful conflict with themselves – since as I indicated before, in his unconscious, every person (especially the successful one) is convinced that he is especially lucky.

Each time that he is forced by circumstances (or by a safety engineer) to think about, or to attend to matters involving safety, he is also forced to accept that he is, after all, *not* something special.

Little wonder then, that the manager so often finds all manner of rationalization for putting off decisions about taking special action concerning safety. This is why efforts to sell safety to management which stress the fear component and in which the "This can happen to you" theme is predominant, so often fails to convince the individual management executive that the "you" part of the message refers to *him.*

USE POSITIVE APPEAL

Looked at in this way, we would seem, at first blush, to have here a problem with no solution. Man's basic nature being what it is, the act of dealing with accidents and accident prevention will probably always carry negative associations for the management men to whom safety programs have to be sold. A positive appeal however, is possible.

This should be based on the very fact that personal insecurity feelings and attitudes are both the underlying reasons for, as well as the deterrents against, taking action with regard to safety problems. What is required here is the stressing of the mental (as well as the economic) security which an adequate safety program provides – not only for the employees whose safety is at stake, but also for management people themselves.

The point is that the very act of planning and implementing a safety program needs to be identified as a gratifying, security enhancing, step for management. This appeal would have to go easy on the negative aspects of the problem, and concentrate upon, and emphasize, the advantages that accrue from the presence of an adequate safety program.

FREEDOM TO MANAGE

Of course, superficially, it may appear to be much easier to list and illustrate all the frightening costs of accidents to management and to attempt to frighten them into action on a safety program. I propose, however, that you are likely to be more consistently successful if, instead, you emphasize the *positive* advantages that result from a positive program.

To do so without making fear arousing comparisons which show the undesirable and costly effects of not having such a program is, of course, not easy. This is where each of you has to use your best intelligence and ingenuity in focusing your selling pitch on the positive highlights. And, in the final analysis what is most positive for management is freedom to manage productively – freedom which they can gain only by eliminating the time and money consuming headaches which accidents involve.

A SAFETY JOB— OR JOB SAFETY?

by JOHN W. GURRY

SAFETY ENGINEERS in industrial plants, laboratories, and insurance accident departments have a special commodity to sell. This commodity is the sum of protection knowledge and ideas which will prevent injury to a fellow human being. How many sales are we making?

Of what good is our storehouse of ideas and experience, if the worker at the end of the management chain is left to clumsily improvise respiratory protection with a wet cloth, or eye protection by pulling down his cap? The lack of proper protection is just as real as if there were *no* safety program.

A technician uses thin wall refrigerator tubing and 45° flared fittings from his tool box on a high pressure manifold connection. It does not help his blasted features a few minutes later to learn that his injury was unnecessary because the stockroom carried a full line of tubing and fittings approved by the engineering department.

We set up the system and thought we had done our job. But we did not sell it down the line. Eighty-five percent of the people suffering injuries in our lab say, in effect, "I knew better than that," or more to the point, "Sure I knew, but someone still should have told me."

HOW TO SELL SAFETY

How do you sell an idea? In this safety business, we have to do more than display goggles and talk hard hats. A recommendation to remove the litter and shavings piled over the motor driving the circular saw will not eliminate the fire hazard. Calling the plant engineer's attention to a ceiling sagging under the weight of electronic gear stored overhead will not shore it up.

John W. Gurry, safety engineer at AVCO-Everett Research Laboratory, has been a member of our Society since 1956 and is a member of the Boston Chapter. He has a B.S. in civil engineering from Union College and has been in safety work since 1953. Mr. Gurry joined AVCO in 1956. This is his first article to be published in the *Journal*.

I was amazed to observe a shop leader argue like blazes to show why a training meeting he had scheduled should not be postponed. Asked why, he said, "I really didn't care, but I just didn't like the idea of being ousted." How hard do you and I fight for what we think should be done? Do we marshal our ideas? Do we look at it the way we think the boss might, point out efficiency improvements and the elimination of lost time or waste?

REDUCTION OF WASTE

Work simplification people tell us that work is the use of time, energy, materials, and space. Good work is the right use of these items. Poor work is wrong use. The difference they call waste. Is there any management that is not reached by an argument to reduce waste of time, materials, or space?

Another way to sell an idea might be to figure how to make *doing it* less painful than *not* doing it. A supervisor who's "done it a thousand times and never had an accident yet" might have to be put to trouble to get an idea across.

The pointed questions, investigations, hearings, and reports he undergoes when one of his men is hurt could prove to be of more trouble than showing his men the proper use of their tools. If the investigation is made for each type of injury which *could* be disabling – whether or not serious injury actually resulted – he might get the "brother's keeper" habit sooner.

If the foreman's unsafe actions shout so loudly his men cannot hear his safety urgings, he himself is not sold. His men will continue to be injured. He may be too.

GO TO THE CONSUMER

The safety engineer may be an expert trouble shooter. He may have every safe procedure written down, every shop properly stocked with protective equipment. He may even be one of those rare persons who does not take the credit when an idea he originated finally gets into action.

His firm will still have a poor disabling injury record if the men do not "buy" the need for accident prevention. Someone's got to bring the product to the customer. You don't sell safety from an office.

the electronic driver

—IS IT COMING?

John W. Leggat, Jr., safety director of the General Motors Technical Center, joined the Society in 1958 and is a member of the Greater Detroit Chapter. He has a B.S. degree from Michigan State University and came to General Motors in 1945. He was named to his present position in 1957. This is Mr. Leggat's first article in the Journal.

by JOHN W. LEGGAT, JR.

THERE IS NO NEED to discuss the extreme interest developed and efforts expended in recent years by government and industry throughout the country toward improved highway safety. Federal, state, city and other governmental agencies each are recognized as having a responsibility in this field.

Not so readily recognized is the fact that the transportation industry, and the automotive industry in particular, also are aware of a responsibility toward improvement of safety in the mechanical equipment and in the method of control of its product, the automobile.

One way to emphasize this sense of responsibility is to describe some past developments of the industry and some of the current work directed specifically toward improvement of the safety aspect of vehicle operation.

Current problems of automotive safety engineers concerned with product safety vary from the loca-

tion, type and control of headlights in the front to the problems relating to a safe exhaust system all the way through to the tailpipe. These engineers are usually dealing with components of cars which will not hit the road until next year or the following year, so that they must anticipate problems which will be precipitated by proposed model changes – both exterior visible changes and hidden mechanical modifications.

But these deal with recognized current problems. What of the more distant future?

Highways are becoming more congested; people want to travel faster; they want to enjoy more of the scenery; and they want to reach where they are going without accident.

Much study is being given these problems across the nation both within the automotive industry and outside it. These studies involve not only automobile improvements, but also highway developments, traffic control and driver education.

One approach suggests itself as a result of recent technological advances in the field of electronics. Electronic equipment is already being applied to the control of aircraft. It may be feasible to adopt such control to automotive travel.

What about radio? How can some of the problems of vehicle control be simplified or eliminated in order to relieve the driver of some responsibilities and permit him to pay more attention to fringe areas which, nevertheless, have been frequent causes of accidents?

One of the major automobile companies has made a study of the frequency with which distracting influences might arise in a driving situation. It revealed that a driver can be exposed to between 15 and 45 events per second in an average driving situation. This same driver can observe in detail only two or three such events and probably reaches decisions at a much lower rate.

NEED FOR CONCENTRATION

Many of these events, naturally, are not hazardous in themselves, but can reduce the opportunity to concentrate on significant details. A passenger in the car can be a help or a hindrance depending upon whether he is alert and gives the driver room, or whether she has her head on his shoulder and is crowding him comfortably. While I would not suggest substitution of an automatic device in the latter case, it does appear to be reasonable to expect to obtain assistance in reducing the need for concentrating attention in some areas.

This is not to say such equipment is currently available, or that if available, *all* traffic problems would be solved. Sound engineering developments in this field must be accompanied by progress in such other areas as enforcement and education. The total problem is extremely complex and there can be no single approach, or panacea, for traffic accidents.

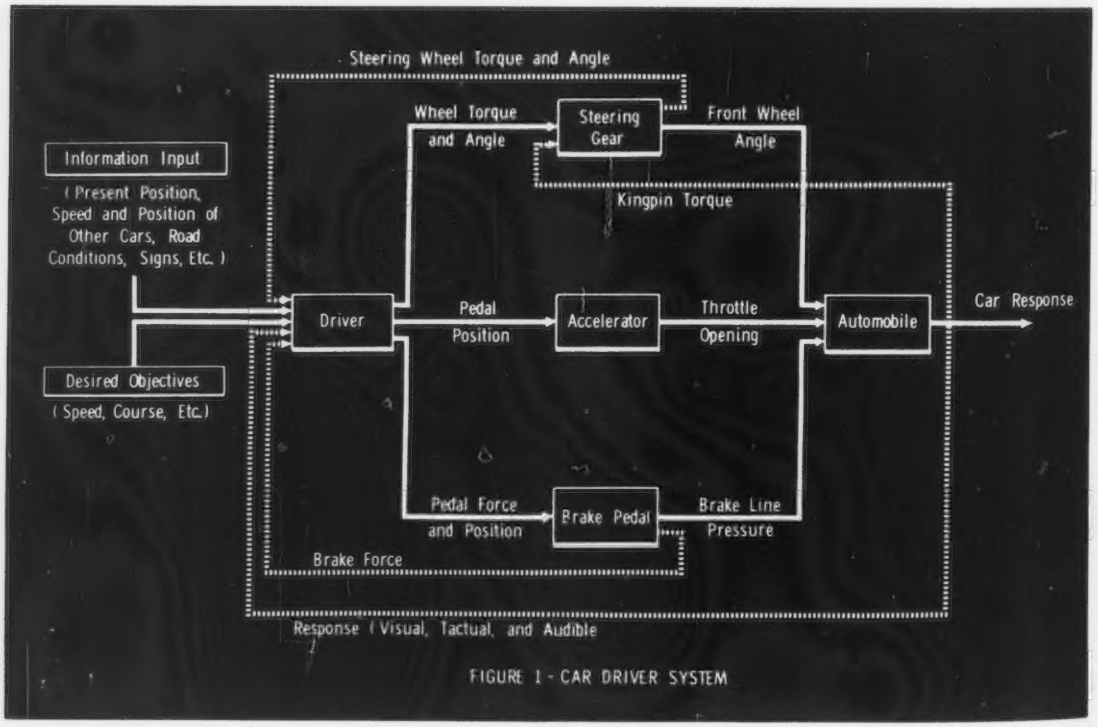


FIGURE 1 - CAR DRIVER SYSTEM

Electronic control of passenger cars precipitates many new problems. Any proposed system can be considered an electronic chauffer or co-driver, so that before development can be completed, we first must know something about the *functions* of the driver.

Drivers have been the subject of intensive study, but I think that with even a cursory examination, we can recognize the complete driver as a very complex being with a very complex job. However, his duties can be basically reduced to the performance of functions of three general kinds.

(1) Perception
(2) Decision
(3) Motor

His senses make him aware of the motion of his own vehicle, the relative position and movement with respect to other vehicles, the desired path, the information on road signs, weather conditions which have an influence upon the car's responses and the presence of pedestrians.

Figure 1 is a simplified block diagram of the car-driver system. Information input to the driver includes those things previously mentioned plus such things the driver has been taught about rules of the road, courtesy, etc. Other input information may originate as side accelleration, audible tire squeal, and steering feel. The driver perceives these things through the use of his visual, audio, and tactile senses. He becomes an integrator of the information in terms of both the present situation and the anticipated immediate future. All these things are perception.

PROCESS OF INTEGRATION

Decisions are reached as a result of this process of integration; and decisions in turn result in motor responses of the driver. In a car these responses result in angular displacement of, and torque inputs to, the steering wheel and in position control of the throttle and brakes.

Development of such devices as power steering and power brakes are past application of mechanical devices intended to reduce control efforts; and automatic headlight dimmer controls and automatic transmissions are examples of devices already available to reduce the number of events faced by a driver in a given situation.

All of the driver's control imputs (or motor efforts) are utilized to regulate the car motion, its speed, position, and heading in the two dimensional space in which it travels.

In reviewing the functions which the driver must perform, it is obvious that he might be further assisted in operating a vehicle by supplying him limited aids for perceiving the situation, by simplifying his decisions, or by reducing his motor effort. One of these devices is Hy-Com, which is intended as a driver aid (spoken of earlier as a co-driver).

Such a device could be made sufficiently compact to permit temporary installation as a car entered a toll road, use while en route, and removal upon exit.

Another approach is a means for completely replacing the driver with a system that will perform all of the necessary functions for automatic operation of the car on such a highway. Here, a magnetic field generated by a current passing through wires buried in the road is coupled with a suitable means of detection mounted in the vehicle. The combination manipulates a servo type steering mechanism and senses obstacles in the path of the car.

AUTOMATIC CONTROL

Upon review of the concept of the completely automatic control system, it becomes apparent that equipment is *probably* required in both the vehicle and the road. Actually, however, the designer has a wide lattitude of choice, as to the proportion of the total equipment required in each. Mechanical means of guidance *could* be mounted in the road with *no* additional equipment in the car. A train represents such an application. It is also within the realm of reason to consider an electronic system within the car with essentially *no* additional equipment in the road. A combination is probably more likely.

Naturally, city driving complicates the automatic control problem and for this reason, initial efforts have been centered around application to controlled access rural highways.

Obstacle detection presents a serious problem in any automatic guidance system. Such a system must sense other vehicles being overtaken or stalled, and even non-metallic objects such as pedestrians, if any true relief is expected for the driver.

On the other hand, the system must be *highly* selective to minimize or eliminate interference by such things as cars stalled or being overtaken in other lanes (see Figure 2) or at the side of the road.

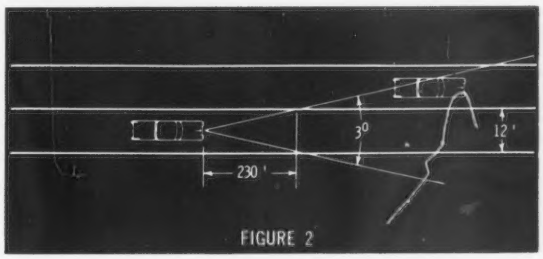


FIGURE 2

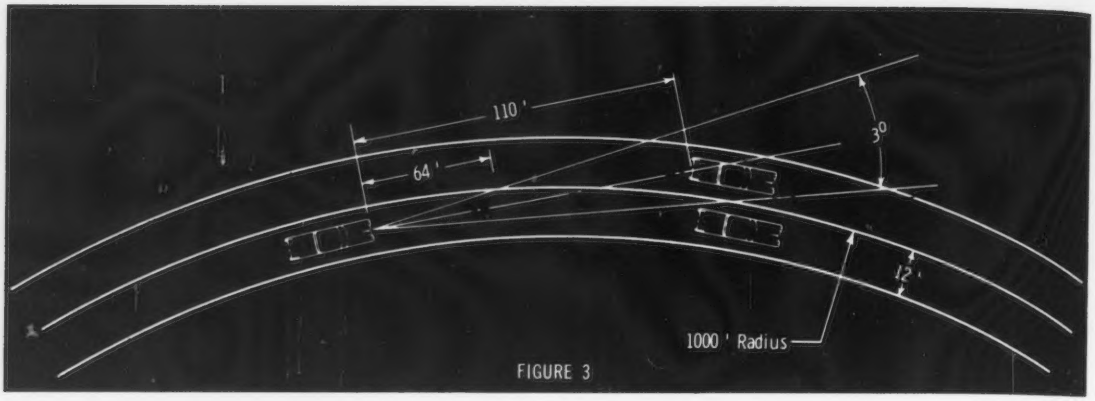


FIGURE 3

Sensing around curves (Figure 3) and at the bottom and the crest of a hill (Figure 4) can be difficult also.

Numerous sensing devices may be adaptable; for example, photocells, radar, ultrasonics, or infra red detectors, but the problem of selectivity and evaluation exists in all but the human senses.

The problem of reliability is not being overlooked. At the present time, vehicle accident statistics reveal that about 96.5 per cent of all accidents result from some driver error. Only about 3.5 per cent are caused by mechanical failure of the vehicle itself.

It has been proposed that the automatic control system could drastically reduce the 96.5 per cent figure. It must accomplish this, however, without a corresponding increase in the current 3.5 per cent figure.

DRIVERS MORE RELIABLE?

Although the general impression is that drivers are relatively unreliable, it is questionable whether even simple electronic devices are as reliable at this time. And it is easy to assume that an electronic control system failure would precipitate an accident of considerable magnitude.

Comparison with National Safety Council figures suggests that control system failure which would precipitate a serious accident could not be permitted more than once per 16,000,000 miles or 400,000 hours to maintain even our present safety record of fatalities. Production of electronic control systems of such reliability is certainly a challenge at the present time.

ADVANTAGES IN DRIVING

Another of the complicating factors which has not been mentioned before is the fact that the substitute control system must not conflict with, or limit the basic advantages inherent in, the use of privately owned cars. Some of these are:

(1) Convenience – opportunity for direct service with complete choice of time or arrival and departure.
(2) Flexibility – Ability to change plans at will.
(3) Comfort – Pleasant environment without need for transfer of personnel or baggage.

In summary, we have been discussing application of engineering technology to improve control and safety of existing types of land vehicles. Such vehicles, themselves, will probably still be recognizable in the forseeable future, but *some* control devices intended to reduce or eliminate driver functions may appear. Many of these developments will perform the *dual* functions of increasing driving pleasure and enhancing safety.

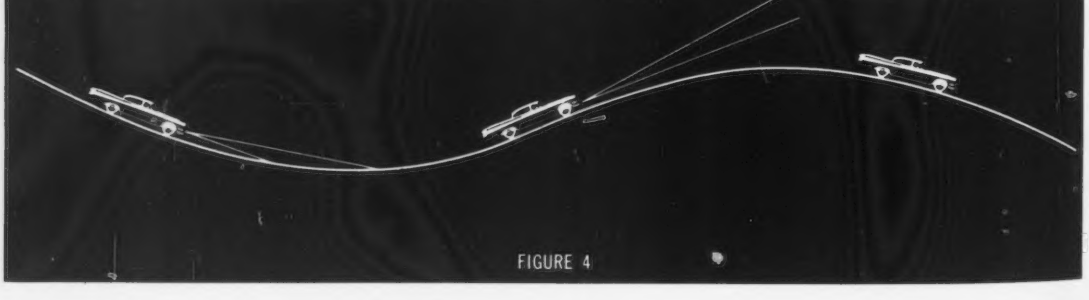


FIGURE 4

Abstracts

SAFETY AND RELATED FIELDS

All abstracts being published in the *Journal* are supplied by Engineering Index Inc., Engineering Societies Library, 29 W. 39th St., New York 18, N.Y. Because of space limitations, comparatively few of the abstracts from this service can be published in each *Journal* issue. However, subscriptions to the service are available from Engineering Index Inc., which will send, on request, a free 16 page catalog describing the service. For a nominal charge, Index subscribers may obtain copies of any of the articles which have been abstracted and, also, English translations of those published in foreign languages.

ACCIDENT PREVENTION

Check List Minimizes Accidents While Drilling with Gaseous Fluids, G. Jackson. *World Oil,* Vol. 151, No. 5 (October 1960), p. 128-33. Guide to safety planning and operation which will simplify work of supervisory personnel. Uses check list technique; check lists, questions and discussions for pre-work safety planning, rigging up and drilling. Check lists are intended primarily for air drilling but can be adapted to natural gas drilling safety.

Injury Experience in Quarrying, 1957 J. C. Machisak, N. W. Kearney, Z. S. Glidden. *U.S. Bureau of Mines—Information Circular* No. 7975, 1960, 55 p. Data on general injury experience, injuries at different kinds of quarries, injury experience by states, selected injury data, and historical injury experience.

Lessons Learned from Accidental Discharge of Ammonia Tanker, L. S. Price. *Canadian Mining Journal,* Vol. 81, No. 9 (September 1960), p. 89-95. Precautions and procedures designed to prevent reoccurrence of accident in which hose failed on temporary ammonia piping arrangement or similar accidents, including regulations for handling liquid ammonia; use of "Lee Hi" high pressure coupling.

Preventing Furnace Explosions, W. L. Livingston. *Combustion,* Vol. 32, No. 3 (September 1960), p. 26-33. Satisfactory system which can reliably prevent furnace explosions will include many inter-related devices and subsystems; conditions that will produce combustion chamber "puff" and proper relationship of flame detector to system capable of preventing those conditions are discussed; scope for development work which should be done before furnace protecting system can be assembled is presented.

Power Plant Safety Program, W. C. Kramer. *Coal Utilization,* Vol. 14, No. 6 (June 1960), p. 21-22. Program in coal fired steam power plant in Indiana with capacity of 600,000 w has resulted in twice attaining 1,000,000 manhours without disabling injury. Every employee is a member of the safety organization and participates through safety meetings, safety suggestions and his elected representatives.

Safety Comes to Electrostatic Spraying. *Engineering,* Vol. 190, No. 4927 (September 23, 1960), p. 418. Advent of Felici electrostatic generator, with flat voltage/current characteristic, inherently safe method of operation and small size; first equipment to use generator is Statron developed by Societe Anonyme de Machines Electrostatiques; Statron comprises electrostatic generator producing 90,000 v, atomizing spray gun with adjustable output up to 5 gal of paint per hr and feeding system for paint; short circuit current of generator is 0.2 ma well below lethal dose.

Safety of Nuclear Powered Merchant Ships, J. Neumann. *Nuclear Engineering,* Vol. 5, No. 47 (April 1960), p. 170-1. Tabulation and analysis of 25 rules proposed by the Ministry of Transport for design and construction of nuclear powered ships to meet necessary safety criteria.

Six Ways to Promote Safety, H. E. Carroll. *Petroleum Refiner,* Vol. 39, No. 7 (July 1960), p. 180-2. To accomplish effectiveness of safety it is recom-

mended to consider use of daily safety report, safety ads, home safety, safety awards, and safety publicity.

Suppressors Tame Explosions When Plant Safeguards Fail. *Iron Age*, Vol. 186, No. 19 (November 10, 1960), p. 174-5. New blast suppressor system suppresses incipient explosions by acting within few thousandths of a second to snuff out blasts before destruction can occur; five-fold action includes suppression (envelopment of explosion with suppressant), venting (opening path to atmosphere for pressure relief), advance inerting (introduction of suppressant into areas away from explosions source to prevent secondary blasts or fires), isolation (blocking of explosion from spreading) and automatic shutdown to protect equipment in other sections of the plant.

What You Should Know About Respirators, H. H. Fawcett. *Air Engineering*, Vol. 2, No. 5, 7, 9 (May 1960), p. 33, (July), p. 46-7 (September), p. 45-7. May: Data on available air supplied respirators. July: Self-supplied respirators, and their applications. September: Smaller self-contained breathing apparatus is discussed; maintenance, training, and general medical precautions, in use of all types of respirators are outlined.

INDUSTRIAL HYGIENE

Air Purification, R. S. Ash. *Institution of Heating and Ventilating Engineers Journal*, Vol. 28 (July 1960) p. 147-9. Use of masking agents, odor counteractants, chemical reactants and adsorption materials for odor control and four methods for air sterilization and air ionization are considered for preventing spread of airborne germs and air contamination; techniques are applicable to hospitals, air raid shelters, schools, restaurants, offices, houses, etc.

Simple Way to Determine Air Contaminants, R. S. Brief. *Air Engineering*, Vol. 2, No. 4 (April 1960) p. 39-41. Simplified way of determining transient contaminant concentrations in in-plant atmosphere; enables maintenance of pure air for safe working conditions. Illustrative examples demonstrate use of nomograph.

MOTOR VEHICLE SAFETY

Cross Median Accident Problems and Corrective Measures in Connecticut, H. S. Ives, *American Highways*, Vol. 39, No. 4 (October 1960), p. 9, 12-14. Analysis of driver deficiency and traffic volume changes which are found to be primary causes for cross median accidents. Preventive measures on future expressways and corrective measures on older expressways and parkways are discussed.

Engineering for Safety With Psychological Yardstick, G. J. Huebner, Jr. *Society of Automotive Engineers* – Paper No. S265 for meeting September 9, 1960 (Detroit Section) 5 p. Problems of evaluating automotive developments in terms of their design suitability and adaptability to human use; ability of man to compare two different quantities was used at Chrysler Research to develop technique for measurement of riding quality of cars; examples given from projects in which analysis of subjective appraisals was used include studies of tire thump and roughness, body shake, engine and exhaust noise, seating comfort, etc.

NOISE CONTROL

Noise Control. *Factory*, Vol. 118, No. 9 (September 1960), p. 109-15. Special report on causes, effect, and control of plant noise; consideration of controlling noise transmission and controlling by personnel protection. Seven methods for noise control are presented.

Interpretation of Noise Spectrograms. *Electrical Manufacturing*, Vol. 66, No. 2 (August 1960), p. 136, 138, 140. How tracing sources and developing remedies for noise in product and equipment design can be accomplished most effectively by analyzing sounds into their component parts, and evaluating elements separately; features of new Audio Spectrum Analyzer which divides sound into bands and measures levels in each frequency range; data are presented graphically.

NUCLEAR SAFETY

Nuclear Accident Survey, J. S. Burkett. *Nuclear Power*, Vol. 5, No. 54 (October 1960), p. 77-80. Review of all known radiation accidents indicates that, with constant care, serious incidents in future atomic energy activities are unlikely. 24 refs.

Safer Packages for Shipping Fuel, W. B. Lewis, R. W. Goin. *Nucleonics*, Vol. 18, No. 7 (July 1960), p. 91, 93. As long as it is possible for packaged units of fissionable materials, each separate package safe in itself, to form critical assembly when units are brought together, hazard of inadvertent criticality will be source of continual concern; shipping sandwich of Cd foil and solid hydrogenous material (wood or polyethylene) is proposed, based on calculations for fictitious nuclear reactor fuel "criticallum," of greater hazard than U-235 or Pu-239; calculated safe dimensions for packaging are summarized in table.

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Membership Information

THE American Society of Safety Engineers has established the following classifications of active membership.

ASSOCIATE MEMBER – To be eligible as Associate Member an applicant shall be at least twenty (20) years of age and

a. Shall have a degree in engineering from a college or university whose curriculum is accredited by the Engineers' Council for Professional Development or shall have legal registration as a professional engineer and, in addition, shall be engaged in safety engineering with at least one (1) year's experience, no time being credited to this one (1) year unless at least fifty (50) per cent of the time was devoted to safety engineering, or shall have supervision over the safety engineering function of his organization; or

b. Shall have a college degree other than that specified in "a" above and, in addition, shall be engaged in safety engineering with at least three (3) years' experience, no time being credited to this three (3) years unless at least fifty (50) per cent of the time each year was devoted to safety engineering; or

c. In lieu of a college degree, shall be engaged in safety engineering with at least five (5) years' experience, no time being credited to this five (5) years unless at least fifty (50) per cent of the time each year was devoted to safety engineering.

MEMBER – To be eligible as a Member an applicant shall be at least thirty (30) years of age, shall have the qualifications required for Associate Membership and also shall have (5) years' experience in addition to that required by and of a type defined in the subsection of the requirements for Associate Member which is applicable to him.

FELLOW – To be eligible as a Fellow, a Member shall be nominated upon the unsolicited recommendation of three (3) other Members, shall be at least forty (40) years of age, shall have been a Member for at least thirteen (13) years, and shall have been engaged in safety enginering for at least twenty (20) years, during at least five (5) years of which he shall have been in responsible charge of the safety engineering function of his organization. In addition, he shall have made an outstanding contribution to the safety engineering profession. Recommendations of candidates for the Fellow classification, along with substantiating data, shall be sent to the Secretary of the Society, who shall submit such recommendations and substantiating data to the Committee on Membership. The Committee on Membership shall report its findings to the Executive Committee for action. Fellows shall be elected by a majority vote of the Executive Committee.

AFFILIATE MEMBER – To be eligible as an Affiliate Member an applicant

a. Shall be at least twenty (20) years of age and shall be engaged in safety engineering with at least one (1) year's experience, no time being credited to this one (1) year unless at least fifty (50) per cent of the time was devoted to safety engineering; he may remain in this classification while qualifying for Associate Member or Member Classification; or

b. Not being engaged in safety engineering, shall be at least twenty-five (25) years of age and shall have pursuits, attainments in accident prevention, or practical experience, extending over a period of at least three (3) years, which shall qualify him to cooperate with members of the Society and to render service to the Society.

for additional information write to

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